Automated Application of Sealant Tape: From a Basic Mechanical System to a Robotic Solution

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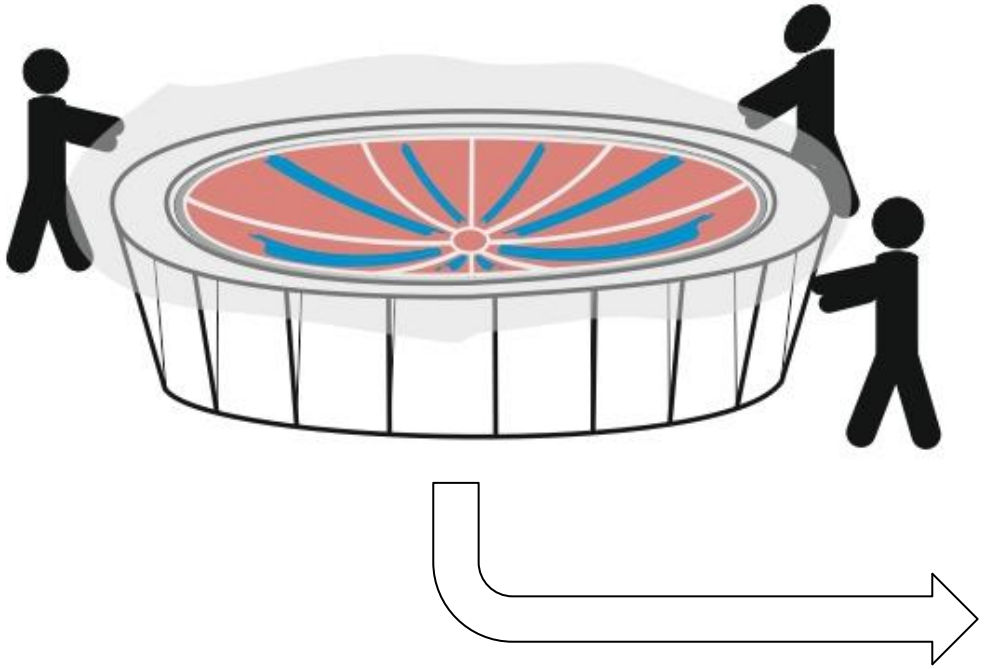
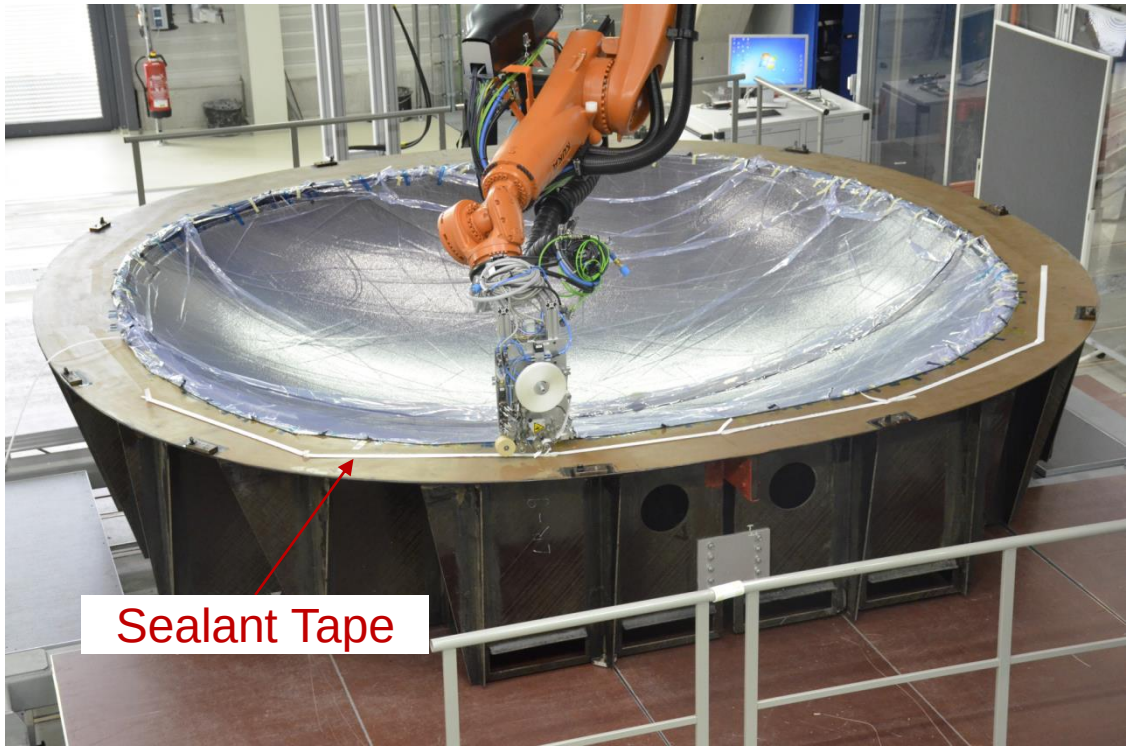
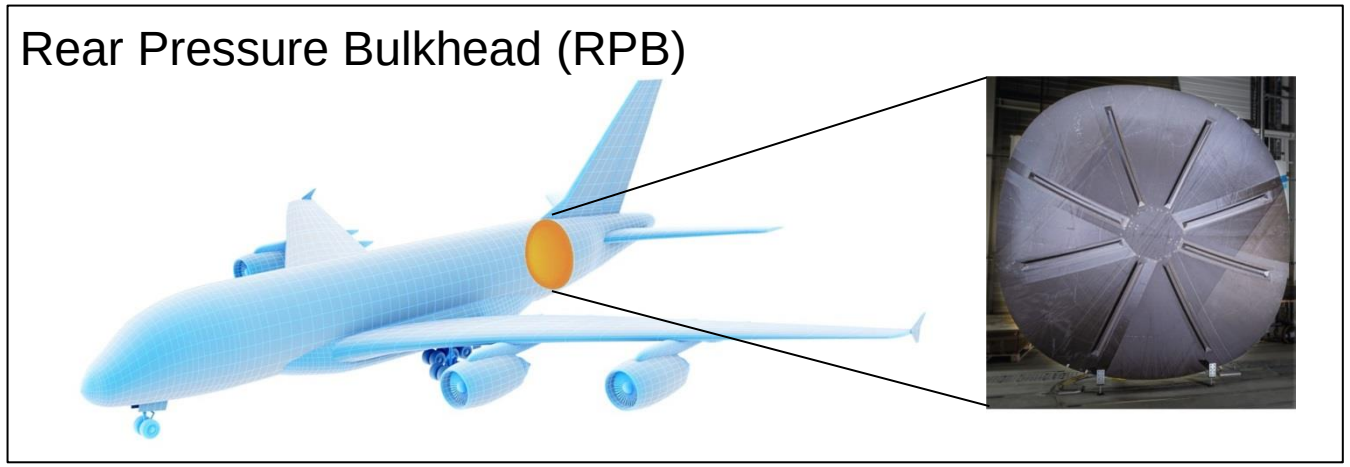
Manual vs. robotic vacuum bagging

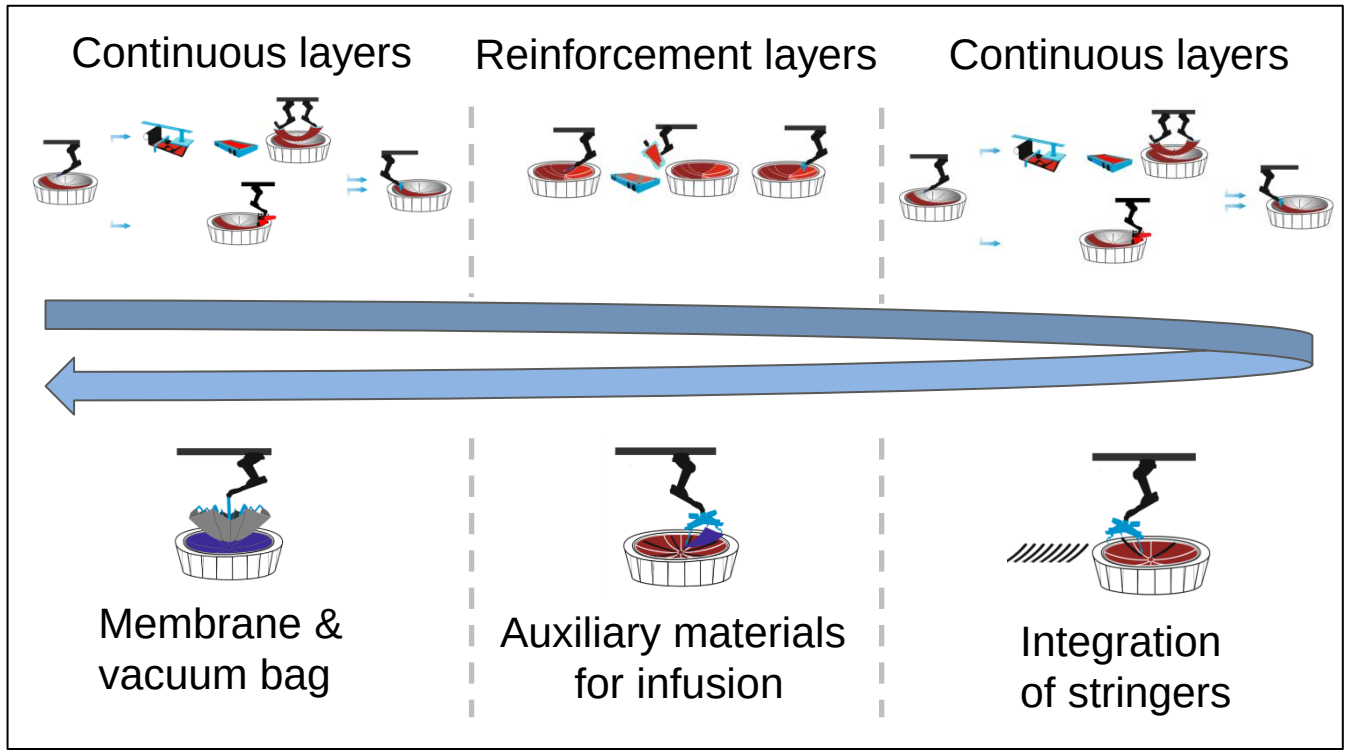




DLR Project PROTEC NSR

- Highly automated robot-based production of a full-scale CFRP rear pressure bulkhead (RPB)
  - Material: Carbon fiber woven + Epoxy resin
  - Process: Liquid resin infusion (VAP)
- Continuous process chain





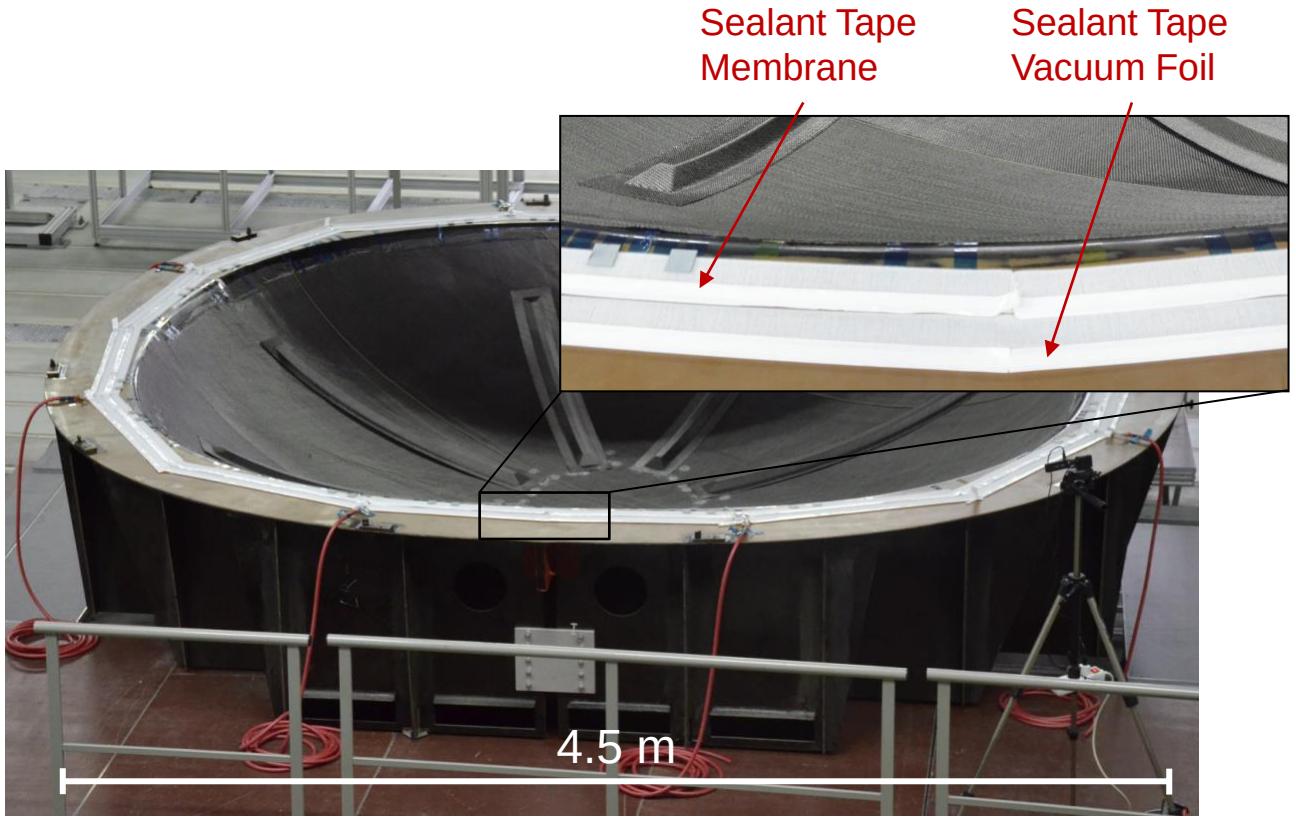
Quality criteria for vacuum bagging

- Position of auxiliary materials
- Position of pleats in membrane and vacuum foil
- Coverage of 3D geometry without bridging
- Air tightness of vacuum bag

→ Exact positioning of sealant tape

Boundary conditions for sealant Tape Application on A350 RPB

- 2 lanes of sealant tape for membrane and vacuum foil
- Sealing on flat tooling surface
- Lanes consist of 16 linear segments (Outer contour of membarne)
- Circumference: approx. 25 m

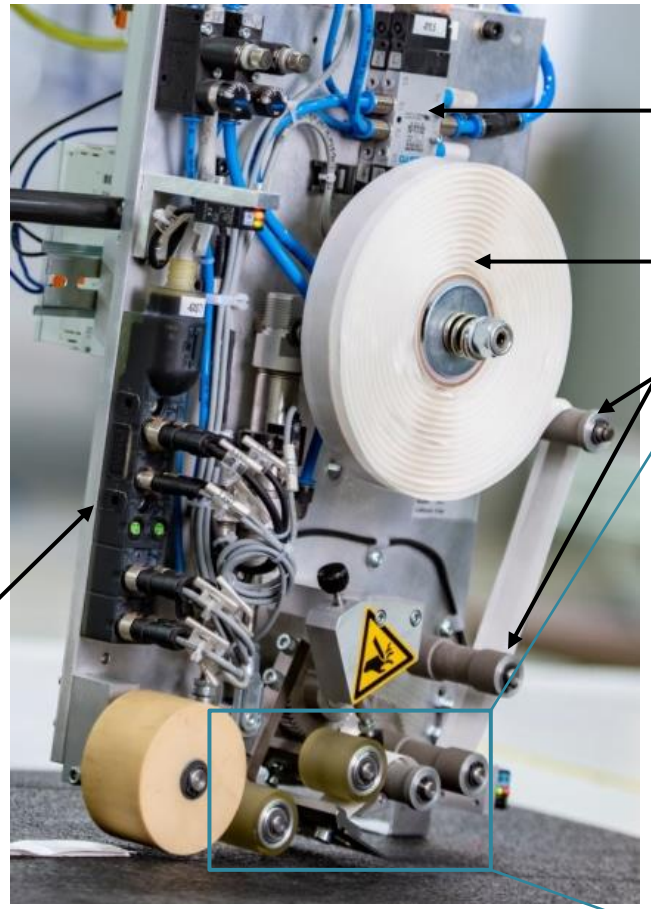


Technical requirements for sealant tape application

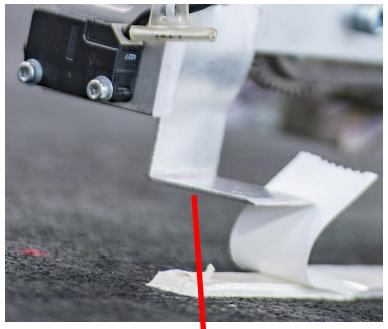
- Sealant tape → GS43-MR, Aero-Consultants AG
  - Elastic sealant (width: 15 mm)
  - Inflexible covering paper (width: 25 mm)
  - Material per roll: 11 m
- Assurance of leak tightness
  - Pressure during application
- Removal of covering paper
  - Joint for next lane

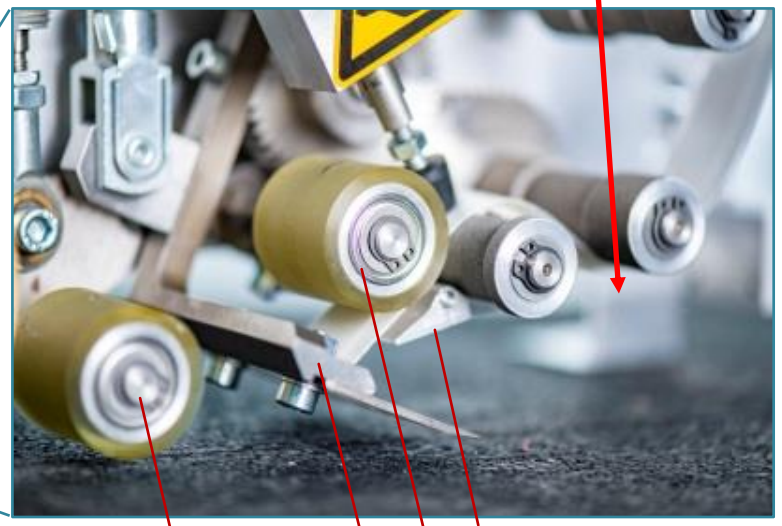
Sealant tape applicator – components and functionalities

- Pneumatik + Electronic control
- Sealant tape feed stock
- Application unit
- Metal scoop

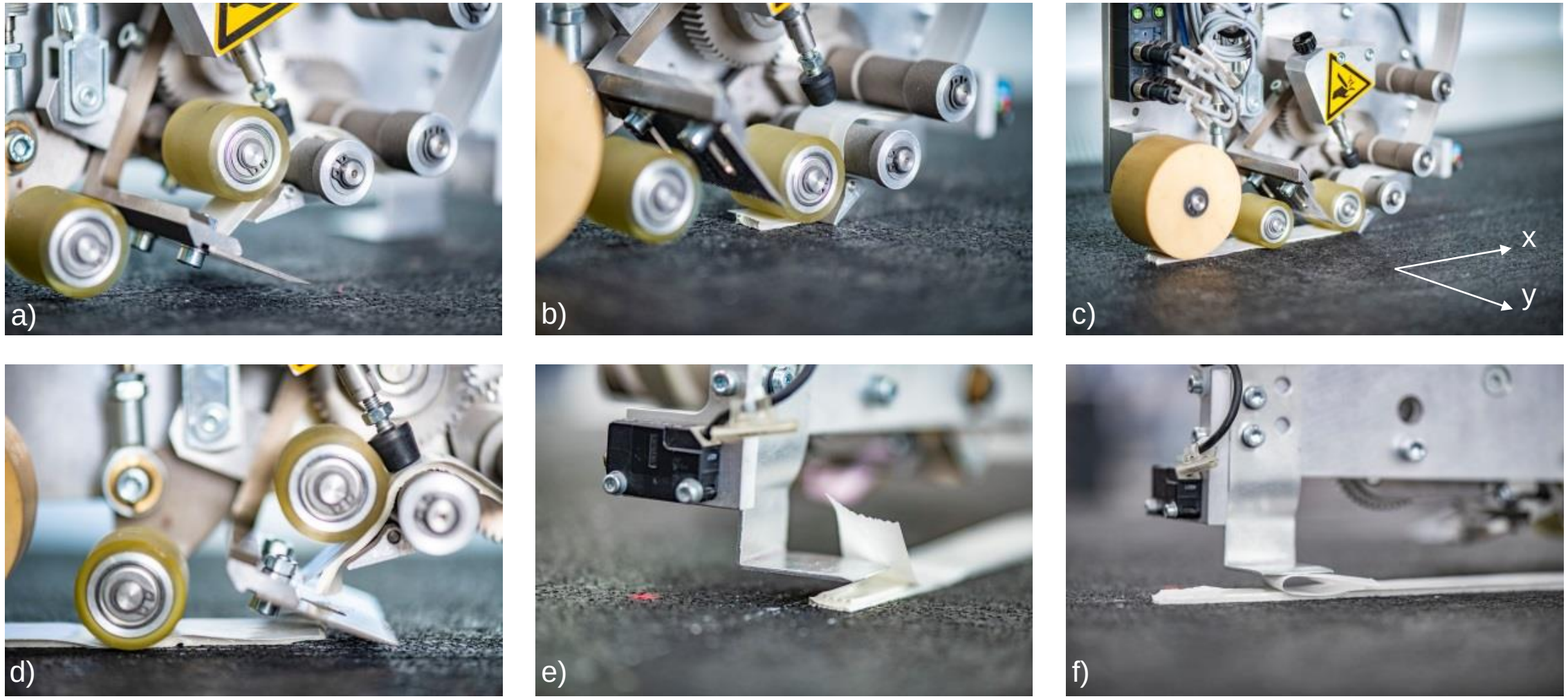


Applicator by
Vulkan Technic GmbH



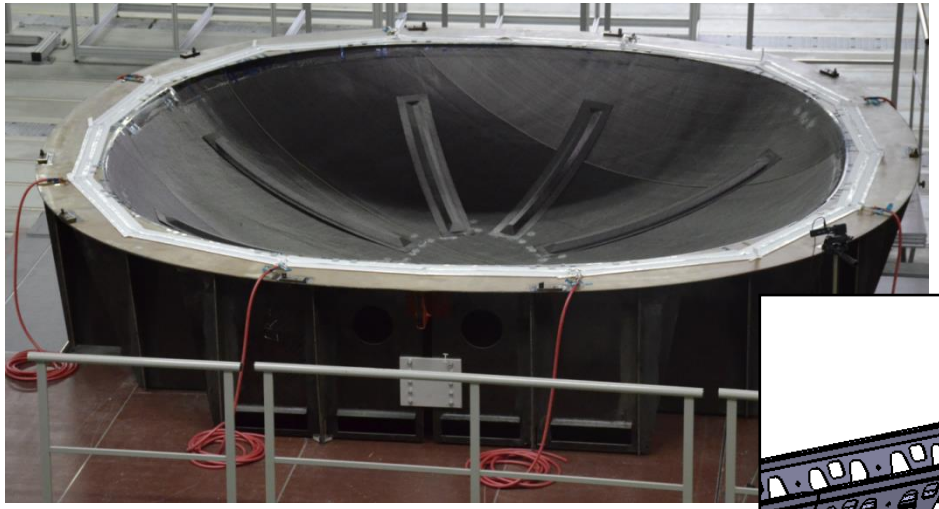


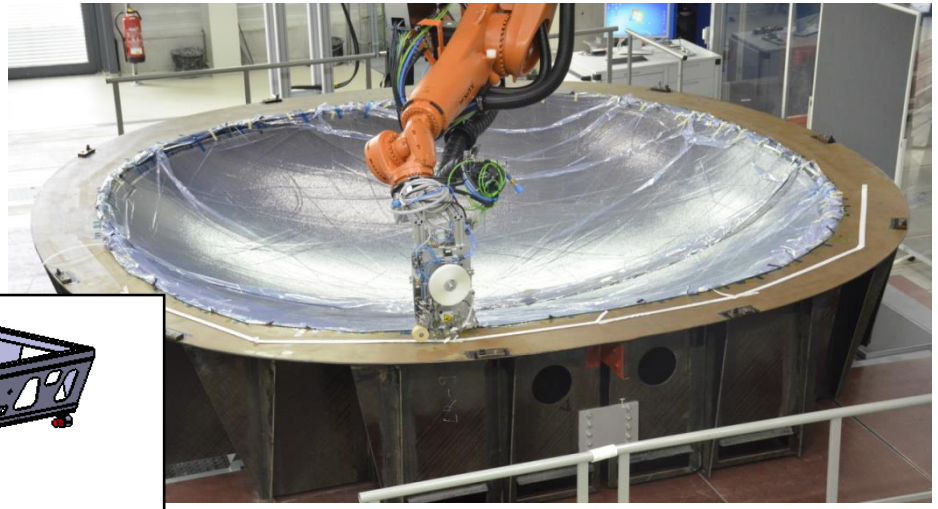
Sealant tape applicator – motion sequence

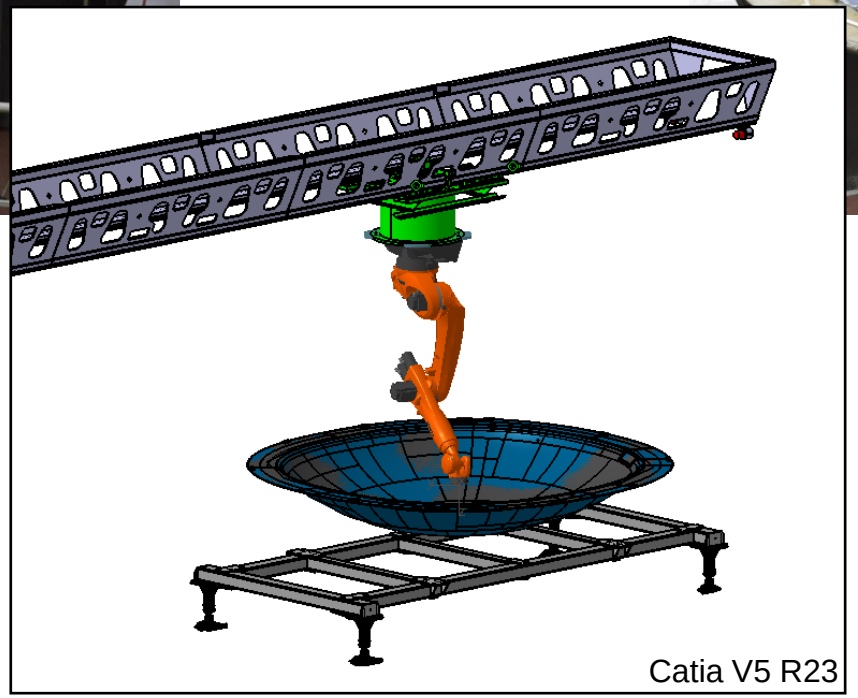


How to implement a robotic controlled use case?

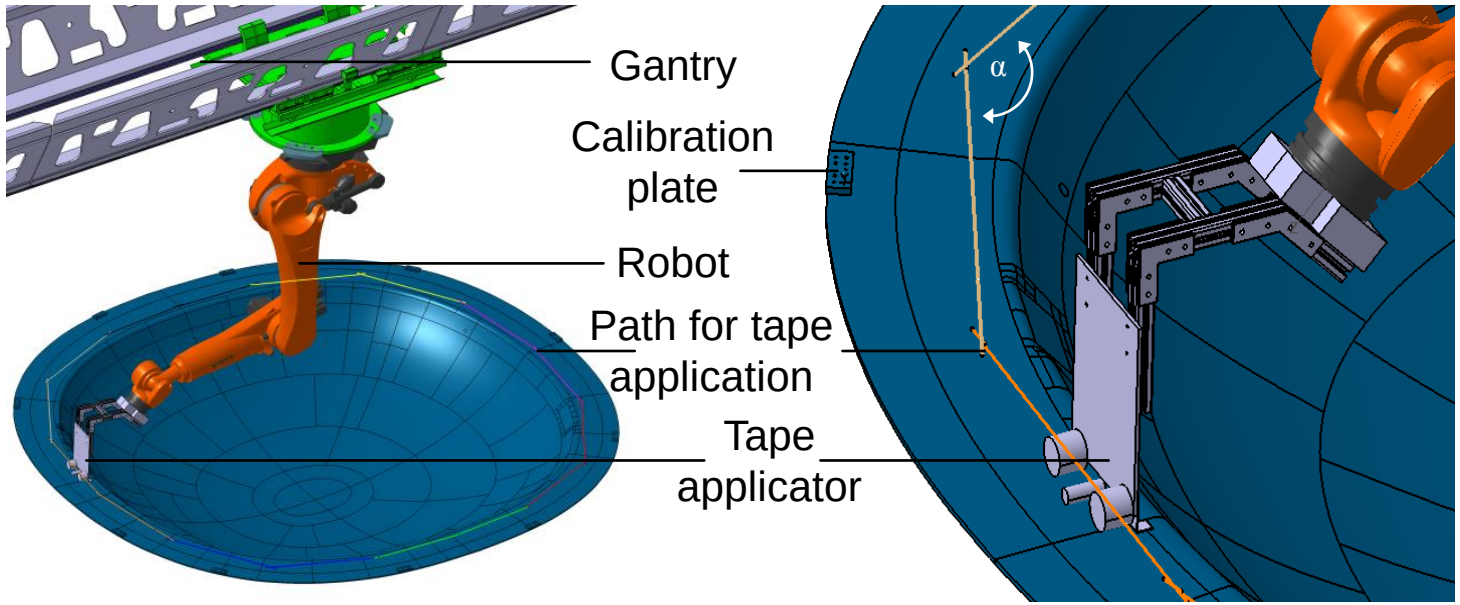
Offline programming and path planning







Offline simulation



Dassault Systems, Delmia, Fastsurf

- Applicator adapted to robot flansh
- Integration of robot path
- Geometric correlation between TCP and robot flansh
- TCP positioned on robot path
- Offline accessibility test
- Data upload to KUKA control panel

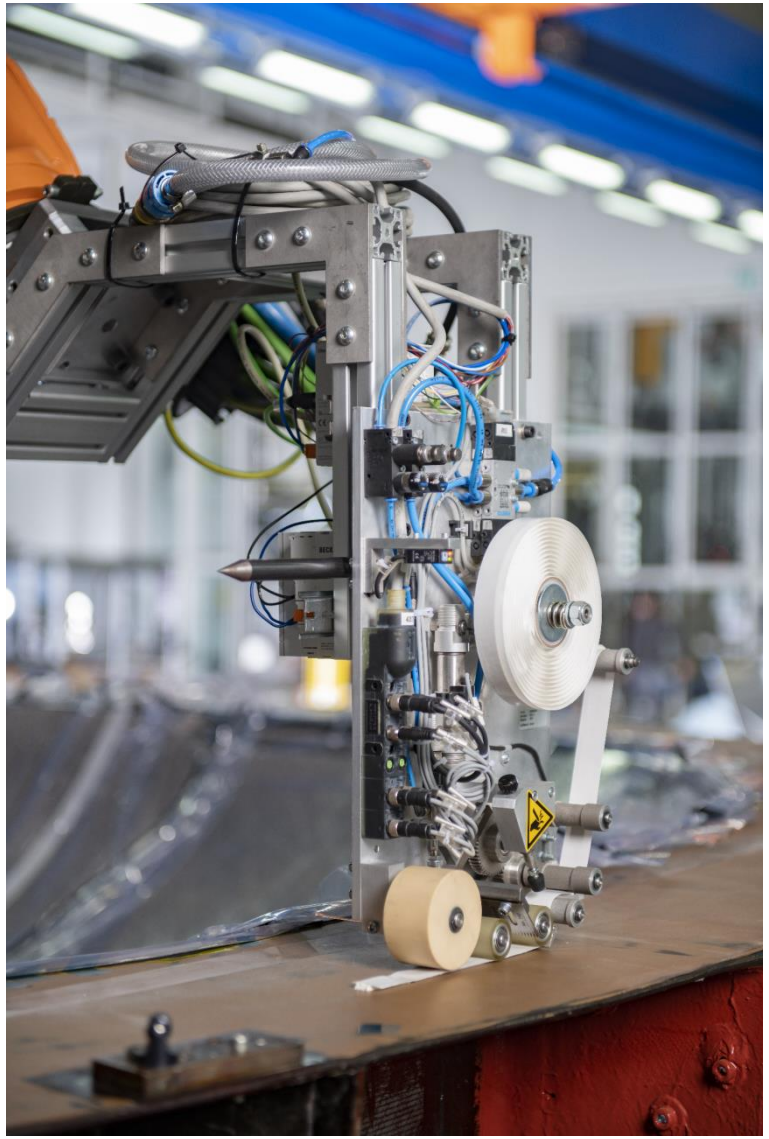
→ Validation in real robot cell

Validation on RPB Tooling

- Successful implementation of motion sequence on even surface
- Manual adaption of TCP on RPB mould surface (deviation of approx. 10 mm)
- Inconsistence of mould surface alongside application path (deviation from CAD model up to 5 mm)

  → Separation of covering paper impossible

  → Distance sensors needed for demonstrator mould



Thank you!

Thanks to my colleagues at DLR
as well as to our partner Vulcan Technik